DOCUMENT RESUME

ED 321 488 EC 231 809

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TITLE	Personal Computers Help Gifted Students Work Smart. ERIC Digest #E483.
INSTITUTION	Council for Exceptional Children, Reston, Va.; ERIC Clearinghouse on Handicapped and Gifted Children, Reston, Va.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO	EDO-EC-90-2
PUB DATE	90
CONTRACT	RI88062007
NOTE	3p.
PUB TYPE	Information Analyses - ERIC Information Analysis Products (071) -- Guides - Non-Classroom Use (055)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Abstract Reasoning; *Cognitive Development; Computer Assisted Instruction; *Computer Uses in Education; *Educational Needs; Elementary Secondary Education; *Gifted; Microcomputers; *Questioning Techniques; Simulation; Student Educational Objectives; Student Needs
IDENTIFIERS	ERIC Digests

ABSTRACT

This digest considers the role of personal computers in the education of gifted students. There is evidence that students are working "smarter," whether they are learning and using more information, understanding key concepts and relationships better, or developing higher level thinking skills. Research findings concerning the specific instructional needs of gifted and talented students are listed. The computer is seen as an idea engine for such students. Although educational uses in computer-assisted instruction, student-developed computer simulations, and programming are recognized, the computer's greatest power is seen to lie in the quality of questions students can ask and attempt to answer. The impact of a nationwide program to encourage students to formulate good questions for a supercomputer is reported. Recommendations include: encouraging experimentation and individual learning styles; structuring experience to help students develop strengths and overcome weaknesses; and promoting interpersonal relationships through computers. Includes eight references. (DB)

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DIGEST #E483 EDO–EC–90–2

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PERSONAL COMPUTERS HELP GIFTED STUDENTS WORK SMART

Since the early 1970s, schools across the nation have been adding instruction in computing to programs for students of all ages and abilities. Gifted and talented students in many schools now have access to computers in their classrooms, and an increasingly large percentage of these students have home computers. As the goals for technology education and the promises of educational change have grown, the hardware and software used in both schools and homes have improved steadily. Educators, business and industry, the government, and the general public believe our most able students must be computer literate for our nation to be competitive in the next generation. Only recently, with the gulf between promises and achievements widening, have voices of concern been raised (Holden, 1989).

The disparity between theory and practice is attributed to many causes, ranging from a lack of educational focus to a shortage of funding. But even those reporting problems have found evidence that students are working "smarter," whether they are learning and using more information, understanding key concepts and relationships better, or developing higher level thinking skills. Gifted students are benefiting from increased use of computers because their special needs are being met through informed use of technology.

The Needs of Gifted and Talented Students

The identification of gifted and/or talented individuals and the determination of their specific needs is complicated by the widely different opinions of what giftedness is and how it is manifested. Basic research is as varied as Howard Gardner's (1983) theory of multiple intelligences and Joseph Renzulli's (1977) dependence on congruence between ability, commitment, and creativity. Most agree, however, that the talents of gifted youngsters are dynamic, rather than static or fixed, and that the youngsters and their talents must be nurtured.

How schools nurture and the effects of various practices are the focus of much research. June Cox (Cox, Daniel, & Boston, 1985), with the Sid W. Richardson Foundation, conducted a national study of current programming for able learners. Donald Treffinger (1986) has written prolifically on gifted programs. Others have explored the relationship of specific processes such as problem finding to nurturing specific talents such as creativity (Getzels & Csikszentmihalyi, 1976).

Combined with practice and experience, the research suggests that the following tenets are essential to good programming for gifted and talented students:

- Instruction recognizes students' unique learning styles.
- Students are supported as they grow in self-confidence and self-awareness of their strengths and weaknesses.
- Students progress at a rate most appropriate for them.
- Structured opportunities are provided for individual and small-group investigations of real problems.
- Students are encouraged to develop and practice higher level thinking skills.
- Opportunities are provided for students to establish goals and determine objectives.
- Students learn with and from each other.
- A wide range and variety of materials and resources are available.
- Student interests are used as a basis for learning.

Computers Are Idea Engines

The computer has evolved well beyond the ancestral calculator that did amazing computations. It has become an idea engine—a tool for discovery, exploration, and collaboration. Computers are designed to process information, and the results they furnish are as limitless as the human beings using them and the problems and applications for which they are employed. Computers can manage data whether the information they store is organized as numbers, names, words, dates, or any combination of facts. Computers can produce graphics in charts, pictures, animation, color, and three dimensions if the necessary peripherals and programming devices are available. They can be used to manipulate text, correct spelling, critique grammar, and speak several languages. When connected with telephone lines or other cabling, they can share information. Instructed properly, computers can make "intelligent" decisions. They do all of this accurately, with speed and increasing flexibility.

Computer Applications

At the simplest level, as intelligent tutors offering computer aided instruction (CAI), computers provide only modest support of program goals for able learners. Instruction is individually paced, different learning styles may be accommodated, and some self-confidence may be gained. However, this use of computers fares poorest in the research. Teachers are still better at traditional stimulus/response instruction.

At a higher level, students are provided opportunities to do research and apply complex thinking skills by working with real problems and computer simulations. Learning becomes fun and more challenging. Some of the best software on the market falls into this category, and the results of time spent with computers in this mode are not easily dismissed.

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Students are taught programming languages that aid them in beginning to turn a computer into a real tool. The LOGO languages and the concepts introduced in *Mindstorms* (Papert, 1980) and the more advanced *Turtle Geometry* (Abelson & diSessa, 1984) provide platforms for students to invent their own syntax, integrate knowledge, and share ideas. All students in gifted and talented programs should be introduced to such computer applications and programming.

Unfortunately, many students never move beyond this level. The newfound mastery of the power of the computer is seductive. Every problem presented can be solved. The graphics are spectacular. Nonusers are awed, and even the teachers are often surpassed; "hackers" emerge. However, little is to be gained from merely a faster CPU, better resolution, gigabytes of storage, or technology. The real power of the computer derives from the quality of the questions students ask and attempt to answer.

Asking Better Questions

In November, 1987, Control Data Corporation challenged students across the country to put their best questions forward as part of a contest to promote a new supercomputer. They wanted to know what students were interested in and how they would use a computer to discover, explore, and collaborate. Teachers were asked to spend the next 6 months building and guiding learning experiences that reinforced and clarified the students' topics. Teams were formed—each student member having an independent project—to pool strategies, share learning, and expand alternatives. Time was spent in the library reading professional journals and investigating tangents. At the end of the school year the students with the best-developed questions (still no solutions) were invited to spend the summer in Minnesota working with a powerful computer and mentors from Control Data staff. After nearly 8 months of investigation, the students reported what they had learned to a panel of scientists who read each paper and spent several hours listening to the students and sharing their own knowledge and experience.

The impact of that program on each of the 1,475 schools that participated nationwide was remarkable. Computers had been used to frame better questions, define important problems, and stretch students farther than they or their teachers had thought possible. These gifted and talented students combined their individual strengths and needs with a conglomerate of people, resources, and technologies that changed their learning experience. It is important to note that the use of computers, although significant, was not the focus of the program. The students were not studying computer science or applications.

Gifted and Talented Students Work Smart

When computers are used to support program goals and meet individual student needs, they can help gifted students work smart.

- When choices are provided and experimentation allowed, individual learning styles and preferences can be accommodated and enhanced through the flexibility of the computer to interact with pictures, words, numbers, or any other medium the student is most comfortable with. The flexibility of the technology is the key concept. Different students find different word processors, graphics packages, databases, and spreadsheets easier to use.
- Structured experiences designed by well-trained teachers can help students use computers to develop strengths and overcome or neutralize weaknesses. Word processors do improve writing and expression of ideas. Databases can be as rigid or open as the student needs. Solving problems and answering questions are satisfying outcomes. Students grow in confidence as they build their repertoire of skills.
- Computers can be used to match students' paces. They are patient and will hold on to an idea for a long time. They do more complex tasks when students are ready to use them in more complex ways. They provide information when students are ready for it.
- When students assume responsibility for the process, they work smarter. Computers serve people. People define problems, set goals and objectives, and determine roles. The better students understand the learning process, the better they will use technology.
- People learn from people. People are on the other end of the information and ideas accessed through a computer. Students have contact with these people via software, bulletin boards, or face to face in discussions and group projects. Students can meet a lot of smart people through computers.

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This publication was prepared with funding from the U.S. Department of Education, Office of Educational Research and Improvement, under contract no. RI88062007. The opinions expressed in this report do not necessarily reflect the positions or policies of OERI or the Department of Education.